

# **Chapter 18**

## **Chi-Square**

# Parametric

Statistical tests (e.g., Pearson's, regression) which make certain assumptions (e.g., normal distribution, homogeneity of variances, independent observations, at least interval measurement) about the parameters of the population from which the sample is taken. Preferred, because more powerful.

# **Nonparametric**

Statistical tests that are used when assumptions of a parametric test are violated. Subjects are usually classified into categories.

# Chi-Square test for Goodness of fit

- Uses sample data to test hypotheses about the shape or proportion of a population. The test determines how well the obtained sample proportions fit the population proportions specified by the null hypothesis.
- **Also known as the one-sample case, indicates whether or not the observed frequencies are a “good fit” to the expected frequencies. There is one variable that contains two or more categories. The observed frequencies are obtained through data collection and the expected frequencies are given. Data is measured at the categorical (nominal) or ordinal level.**

# Null Hypothesis

- **No preference** (equally divided): Used in situations in which a researcher wants to determine whether there are any preferences among the categories or whether the proportions differ from one category to another.
- **No difference from known population:** Used when a specific population distribution is already known.

# Ha

Simply states that the population distribution has a different shape from that specified in  $H_0$ .

# Data

- **Observed frequencies:** observed # from sample
- **Expected frequencies:** predicted from  $H_0$

# Is there any preference among the four orientations?

	<b>Top Up</b>	<b>Bottom Up</b>	<b>Left Side Up</b>	<b>Right Side Up</b>
<b>Observed Frequencies</b>	<b>18</b>	<b>17</b>	<b>7</b>	<b>8</b>
<b>Expected Frequencies</b>	<b>12.5</b>	<b>12.5</b>	<b>12.5</b>	<b>12.5</b>



## **1. State the Hypothesis:**

Ho: There is no preference.

Ha: There is a preference.

## **2. Locate CR:**

$$df = C - 1 = 4 - 1 = 3; \alpha = .05$$

C = # of Categories

Table 18.2 or B8

$$CV = 7.81$$

### 3. Calculate chi-square statistic:

$$\begin{aligned}\chi^2 &= \sum \frac{(f_0 - f_e)^2}{f_e} = \frac{(18 - 12.5)^2}{12.5} + \frac{(17 - 12.5)^2}{12.5} \\ &\quad + \frac{(7 - 12.5)^2}{12.5} + \frac{(8 - 12.5)^2}{12.5} \\ &= \frac{30.25}{12.5} + \frac{20.25}{12.5} + \frac{30.25}{12.5} + \frac{20.25}{12.5} \\ &= 2.42 + 1.62 + 2.42 + 1.62 \\ \chi^2 &= 8.08\end{aligned}$$

#### **4. State a Conclusion:**

Given that the chi-square statistic (8.08) is greater than the critical value (7.81), the alternative hypothesis is accepted ( $p < .05$ ).

There is a preference,  $\chi^2(3, n = 50) = 8.08, p < .05$ .

# Chi-square test of Independence

- Uses frequency data from a sample **to assess whether or not there is a relationship between two categorical variables** in the population.
- Also known as the **two-sample case or Crosstabulation**, **compares observed frequencies of occurrence with expected frequencies. There is more than one variable where each variable has two or more categories.** The observed frequencies are obtained through data collection and the expected frequencies are computed based on total group response. Data is measured at the categorical (nominal) or ordinal level.

# Is there a relationship between gender and willingness to use mental health services?

No                      Maybe                      Yes

Male	17	32	11
	<b>12</b>	<b>30</b>	<b>18</b>
Female	13	43	34
	<b>18</b>	<b>45</b>	<b>27</b>

Note: Expected frequencies are in bold.

## **1. State the hypothesis:**

Ho: There is no relationship between gender and willingness to use mental health services.

Ha: There is a relationship between gender and willingness to use mental health services

## **2. Locate CR:**

$$df = (R-1)(C-1) = (2-1)(3-1) = 2$$

R = Rows, C = Categories

Table B8:  $CV = 5.99$

### 3. Calculate Chi-square statistic

$$\begin{aligned}\chi^2 &= \sum \frac{(f_0 - f_e)^2}{f_e} = \frac{(17-12)^2}{12} + \frac{(32-30)^2}{30} + \frac{(11-18)^2}{18} \\ &\quad + \frac{(13-18)^2}{18} + \frac{(43-45)^2}{45} + \frac{(34-27)^2}{27} \\ &= \frac{25}{12} + \frac{4}{30} + \frac{49}{18} + \frac{25}{18} + \frac{4}{45} + \frac{49}{27} \\ &= 2.08 + 0.13 + 2.72 + 1.39 + 0.09 + 1.82 \\ \chi^2 &= 8.23\end{aligned}$$

#### **4. State a Conclusion:**

Given that the Chi-square statistic (8.23) is greater than the CV (5.99), the alternative hypothesis is accepted ( $p < .05$ ).

There is a relationship between gender and willingness to use mental health services,  $\chi^2 (2, n = 150) = 8.23, p < .05$ .



# Practice Problems

- P. 639; 1, 3, 7, 15